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ABSTRACT

The purposes of this study were to test for both forward and backward effects of inserted questions in prose material, and to determine the conditions under which each in most effective. The conditions examined were the relationship between the inserted questions and the subsequent questions on which learning facilitation was revealed, and the textual distance of the material tested from the inserted questions. Subjects for the experiment were 140 undergraduate students who were randomly assigned to one of five treatment groups: inserted questions (EQ) at three varying positions in the reading material (E1, E2, E3), no inserted questions (C), and inserted questions irrelevant to the preceding material (CQ). The treatments used formed two seperate studies. Groups E1, C, and CQ comprised one study (A) and groups E2 and E3 the other (B). The results from study A indicated no significant difference between C and CQ. Thus, the effect of increased attentiveness occurs only with the insertion of text related questions. In study B the results indicated that group E3 was significantly superior on matched items, regardless of distance from the inserted question, but there was no significant difference on unmatched items. (WR)

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June 30, 1973

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SHAPING AND/OR REVIEW FUNCTIONS OF QUESTIONS IN PROSE MATERIAL

The insertion of questions in prose material has been shown to facilitate learning from the material (Rothkopf, 1966). The effects of these questions are both direct, facilitating subsequent performance on identical questions, and indirect, facilitating performance on other questions about the text materials. The effect is marked when the questions refer to preceding material in the text (post-questions) but may even be reversed when they refer to subsequent material (pre-questions) (Frase, 1968; Frase, Patrick and Schumer, 1970; Rothkopf, 1966).

Although both direct and indirect effects have been reported, the operation of these effects has not been clearly explicated. One conjecture is that the questions serve to shape inspection behaviors thus facilitating performance on posttest items dealing with material following the questions in the text (Rothkopf, 1963). That is, the effect of the questions is forward in that they influence the inspection of materials that have not yet been read. From this point of view inspection behaviors are seen to be reinforced (and, thus, maintained) if the inserted questions can be answered, or non-reinforced (and, thus, altered) if the inserted questions cannot be answered. A number of studies have strengthened this shaping hypothesis. Rothkopf and Bisbicos (1967) observed that the facilitation was greater towards the end of the text and that it was selective, being greatest for items in the criterion test which were similar to those in the original text. Rothkopf and Coke (1968) found that learning was an increasing function of the likelihood that fragments of the text were noticed. Frase (1969), in demonstrating the effects of different organizations of prose material, showed that learning was determined by the aspects of the text to which the learner could attend.

Such a forward effect need need not operate only through shaping appropriate inspection behaviors, causing *S*s to attend to appropriate features of the text. It may also function by simply controlling the level of attentiveness, causing the reader to attend more carefully to the material following each set of inserted questions. The effect of the questions would be cyclic, with the effect diminishing as the reader moves through the material following the questions but being reinstated following the next set of questions. An explanation only in terms of shaping appropriate inspection behaviors would predict a cumulative improvement rather than a cyclic effect. Although there are no clear data to support this second hypothesis there is some suggestive evidence. Rothkopf and Bloom (1970), for example, found that reading rate slowed after each set of inserted questions.

The two hypotheses discussed above postulate a forward facilitative effect for post-questions. However, the experimental results to

date have not ruled out the possibility of the indirect facilitative effect of questions being a backward, or review, effect. Frase (1968) noted that the superiority of post-questions over pre-questions occurred even on the first paragraph (though this could not be attributed to a suppressive effect of pre-questions). Watts and Anderson (1971) found no increase in performance towards the end of their material. Bruning (1968) demonstrated that there is an additive review component in the effect of post-questions.

If the facilitative effect of inserted questions is, at least in part, a review effect, then the facilitation could be expected to be greater for criterion test items which deal with material related to that reviewed in answering the inserted questions. Rothkopf and Bisbicos' (1967) observation of greater facilitation on criterion test items similar to questions inserted in the text could be accounted for in this manner. Further, such a review effect could be expected to be stronger with short preceding lags, that is, with material read shortly before the inserted questions and weaker with longer lags.

If the facilitative effect of inserted questions is, at least in part, a respondent phenomenon--with the effect of the questions increasing the attentiveness of material following the questions--then the effect should be greatest with short following lags, that is, on material immediately following the questions and weaker with longer lags.

The purpose of the present study was to test for both forward and backward effects of inserted questions, and to determine the conditions under which each is most effective. The conditions examined were the relationship between the inserted questions and the subsequent questions on which facilitation was revealed, and the textual distance of the material tested from the inserted questions.

METHOD

Materials

The basic material used in the reported experiments was a selection of material from Rachel Carson's book, *The Sea Around Us*. The text was multilithed onto 21 pages of approximately 260 words each. From each page of the material three questions were developed. All 63 questions were of the completion type and required the recall of specific information from the text. The questions were prepared so that, for each page, two of the questions dealt with the same material, while the third dealt with an unrelated topic.

The pairs of questions dealing with the same material were

developed in such a way that, although they dealt with the same text material, neither could be answered from a knowledge of the answer to the other. For example, from the following passage in the text a pair of questions were formed.

> *Then from the surveying ship Bulldog, examining a proposed northern route for a cable from Faroe to Labrador in 1860, came another report. The Bulldog's sounding line, which at one place had been allowed to lie for some time on the bottom at a depth of 1260 fathoms, came up with 13 starfish clinging to it.*

The two questions developed were:

> (a) *The surveying ship which recovered starfish from a depth of 1260 fathoms in 1860, was exploring a route for a cable from Faroe to* _____.
>
> (b) *The surveying ship* _____, *which recovered starfish from a depth of 1260 fathoms in 1860, was exploring a route for a cable from Faroe.*

The third question developed from the same page as this pair required the name of an Arctic explorer.

Thus 42 of the 63 questions were matched in pairs. Of these 42, 21 (one chosen at random from each pair) were selected for insertion in the text material for the various experimental treatments. These inserted questions are referred to as *EQ*s. The remaining 42 items, 21 matched and 21 unmatched with the *EQ*s were used to form a criterion test (*T1*). The 21 *EQ*s were also used in a criterion test (*T2*) given after *T1*.

Test *T1* was intended to measure the general facilitative effect of *EQ*s whereas test *T2* was to measure specific learning of the material tested by *EQ*s. The two tests were bound into a single test booklet.

A general measure of reading ability was obtained for all *S*s by administration of Part II (Reading) of the Reading Comprehension Test (Form 1A) from the E.T.S. Cooperative English Tests.

Treatments

Three experimental treatments and two control treatments were used. All text materials were bound into booklets which were distributed in random order, and all *S*s took part in the experiments at the

same time. Because *S*s could see one another they were told explicitly, in the printed instructions at the front of the booklet, that, although all booklets contained the same passages, some were arranged differently from others and that they should not be concerned if other *S*s appeared to be involved in writing, for example, when they were not. The instructions to all *S*s were to "study each page of the chapter carefully, paying close attention to facts and figures and to names and dates."

The treatments, summarized in Figure 1, were as follows:

E1. Experimental Group 1: After the first six pages, i.e., after Sections A and B at position ab, a sheet was bound into the text booklet with the six *EQ*s from those pages. Similar sheets, each with three *EQ*s from the preceding three pages, were bound into the text booklet after the ninth, twelfth and fifteenth pages, i.e., at positions c, d, and e, respectively. Thus, inserted questions always referred to preceding material.

E2. Experimental Group 2: Questions were inserted in the text at positions ab, d, and f in a manner similar to that for E1.

E3. Experimental Group 3: Questions were inserted in the text at positions c, e, and g.

C. Control Group: No insertions were included in the text booklets. After the instructions, *S*s simply read the 21 pages of text.

CQ. Control Group with Questions: At the same points in the text as for the E1 group, a corresponding number of irrelevant questions (*CQ*s) from a Personal Opinion Scale, adapted from a dogmatism scale (Rokeach, 1960), were introduced. These questions required approximately the same time to complete as the *EQ* items. The purpose of this treatment was to determine the effect of providing break points in the reading without text related questions.

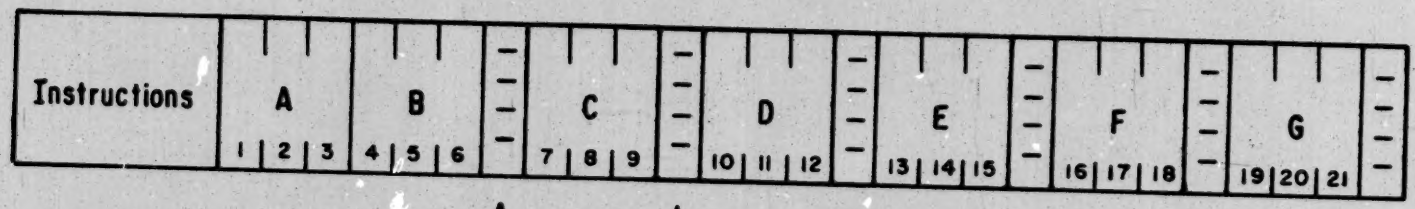
Subjects

Subjects for these experiments consisted of 140 undergraduates, obtained as paid volunteers, at Concordia Teachers College, River Forest, Illinois. Twenty-eight *S*s were assigned at random to each of the treatment groups.

Procedure

All *S*s attended a single group session. The reading comprehension test, requiring 25 minutes, was administered first. The experimental booklets were then distributed to *S*s, who worked through them

TEXT SEQUENCE:
Sections A-G
and Pages 1-21



TREATMENT GROUP INSERTS BY EXPERIMENTS

	Group	Insert ab	Insert c	Insert d	Insert e	Insert f	Insert g
EXP. A.	E1	6EQs	3EQs	3EQs	3EQs	----	----
	C	----	----	----	----	----	----
	CQ	6CQs	3CQs	3CQs	3CQs	----	----
EXP. B.	E2	6EQs	----	3EQs	----	3EQs	----
	E3	----	3EQs	----	3EQs	----	3EQs

Fig. 1. Text booklet sequence for different treatment groups in Experiments A and B.

at their own pace. When a *S* completed his booklet, he indicated this to a monitor who removed it and provided him with a test booklet containing both tests *T1* and *T2*. *S*s were allowed to leave the room when they had completed both tests. The entire procedure required about 90 minutes for the slower *S*s.

RESULTS AND DISCUSSION

The treatments used in this study form two separate experiments. Groups E1, C and CQ comprise one experiment (Experiment A) and groups E2 and E3 the other (Experiment B). The results for these are presented separately.

EXPERIMENT A

Facilitative Effect of Inserted Questions

Mean scores, raw and adjusted, on the two criterion tests *T1* and *T2*, are shown in Table 1. The adjustment resulted from the use of

TABLE 1

Mean Scores on Criterion Tests by Groups for Experiment A

	T1		*T2*	
Group	Raw Mean	Adjusted Mean	Raw Mean	Adjusted Mean
E1	15.7	16.0	8.14	8.27
C	13.5	13.5	4.25	4.23
CQ	14.1	13.8	4.64	4.52

reading comprehension test scores as a covariate. (Test *T2* actually contained 21 items but, for this analysis, only those 15 inserted in the text for group E1 were used.) For test *T1*, the differences among the adjusted means were significant, $F(2,80) = 3.53$, $p < .04$.

The difference between the two control groups was not significant. Thus, there was no support for the hypothesis that the facilitative effect of inserted questions was due to increased attentiveness following a rest from reading. That is, the effect apparently occurs only with the insertion of text related questions such as the *EQ*s.

On test *T2* the performance of group E1 was similarly superior to that of the control groups, $F(2,80) = 25.86$, $p < .001$. Again the difference between the control groups was not significant. Control group *CQ* was, therefore, dropped for subsequent analyses.

Forward or Backward Effect

Groups E1 and C were compared on the 12 items in *T1* from sections A and B (the first six pages, read before any questions were encountered) and the 12 items from sections F and G (read after the last questions had been encountered). A forward effect would be expected to produce superiority of E1 on the FG items while a backward effect should rpoduce superiority of E1 on the AB items. The adjusted means are given in Table 2.

TABLE 2

Adjusted Means on AB and FG Items in Test *T1* by Groups for Experiment A

		Items		
		AB	FG	Overall
Groups	E1	2.05	4.86	3.46
	C	1.80	4.31	3.05
	Overall	1.93	4.59	3.25

The difference between the groups was not significant, $F(1,53) = 1.72$, $p > .18$. Although the overall difference between scores on AB and FG was significant, $F(1,54) = 98.15$, $p < .001$, it is of little substantive importance since no attempt was made to control for differences in item difficulty. The substantively important groups by sections (AB, FG) interaction was not significant, $F(1,54) = .11$.

There are theoretical grounds, however, for believing that forward and backward effects might operate in a more limited fashion than could be revealed in such a gross analysis as that shown above. A review effect should be greater for criterion items matched with the inserted questions and, in particular, for matched items testing material from pages which immediately preceded the inserted questions. An attentional increase following inserted questions would, on the other hand, exert the greatest effect on material from pages immediately following the inserted questions--an effect which should be revealed by both matched and unmatched items.

In order to test these hypotheses performance on all criterion test (*T1*) questions dealing with material from pages immediately before and immediately after inserted questions was considered. Pages 6, 9, 12 and 15 were those "before" insertions and pages 7, 10, 13 and 16 were those "after" insertions. From each of these pages there were two questions on test *T1*, one matched and one unmatched with one of the questions on the adjacent insert. Mean performances for the groups are shown in Table 3.

TABLE 3

Adjusted Means on Matched and Unmatched Items Before and After Inserts by Groups for Experiment A

	Matched		Unmatched	
Groups	Before	After	Before	After
E1	1.59	2.05	1.95	2.41
C	1.01	1.87	1.79	1.87
Overall	1.30	1.96	1.87	2.14

Analysis of covariance (Table 4) revealed group E1 to have been significantly superior to group C in overall performance, $F(1,53) = 4.02$, $p < .05$. The significant effect for position does not

TABLE 4

Analysis of Covariance for Matched and Unmatched Items Before and After Position of Inserts for Experiment A

Source	SS	df	MS	F	P
Between subjects					
Groups [G]	7.44	1	7.44	4.02	.047
Subjects within groups [S(G)]	98.05	53	1.85		
Within subjects					
Position of items [P]	12.07	1	12.07	14.67	.000
PxG	.00	1	.00	.00	
PxS(G)	44.42	54	.82		
Type of item [I]	7.87	1	7.87	13.89	.001
IxG	.01	1	.01	.03	.854
IxS(G)	30.60	54	.56		
IxP	2.16	1	2.16	3.74	.055
IxPxG	2.16	1	2.16	3.74	.055
IxPxS(G)	31.17	54	.57		

demonstrate that performance on items from pages after questions was superior. Since the P x G interaction effect was not significant, the position effect was due only to differences in item difficulty. The same is true for the significant effects for item type and position x item type interaction.

The important effect in this analysis is the I x P x G interaction effect. Although the test of this effect fell just above the conventional level of significance, $F(1,54) = 3.74$, $p < .055$, it is examined here in some detail since a supplementary analysis of the data in Experiment B, reported later, showed the effect to have been replicated there. This result indicates that the groups by position of items interaction for matched items was significantly different from that for unmatched items. The effect is shown in Figure 2, from which the trend in the data can clearly be seen. Tests of simple main effects (Winer, 1962, p. 323) showed that E1 was significantly superior to C on matched items from pages immediately before inserted questions, $F(1,215) = 4.96$, $p < .05$, and on unmatched items from pages immediately after inserted questions, $F(1,215) = 4.30$, $p < .05$.

For the unmatched items there is little likelihood of a review effect operating. The results observed with unmatched items can readily be accounted for in terms of a forward effect. After each set of inserted questions *S*s appeared to attend more carefully to the text, hence the superiority of E1 over C on items from the first page after each insert. On continuing to read the attentiveness to the text presumably diminished with a consequent drop in the relative level of performance of E1. Such a pattern can be seen in the data when it is recognized that pages referred to as "before" inserts were three pages after the prior insert. For the unmatched items it seems more useful to distinguish the page positions as "shortly after" and "long after" rather than "after" and "before." E1 was superior to C on questions from pages shortly after inserts but the effect was attenuated with increasing textual distance from the insert--the difference between the groups on the "long after" pages being insignificant.

Such a forward effect should also operate with the matched items but, with these items, there is the additional possibility of a review effect facilitating performance on material from pages prior to the inserts. The data for the matched items suggest that such a review effect did, in fact, operate. E1 was significantly superior to C on matched items from pages immediately prior to inserts but not on pages after the inserts. These "after" pages, for consideration of a review effect, are better referred to as "long before" inserts. Just as the facilitative forward effect on the unmatched items was attenuated with increased textual distance after the insert, the facilitative review effect on matched items was attenuated with increased textual distance after the insert, the facilitative review effect on matched items was

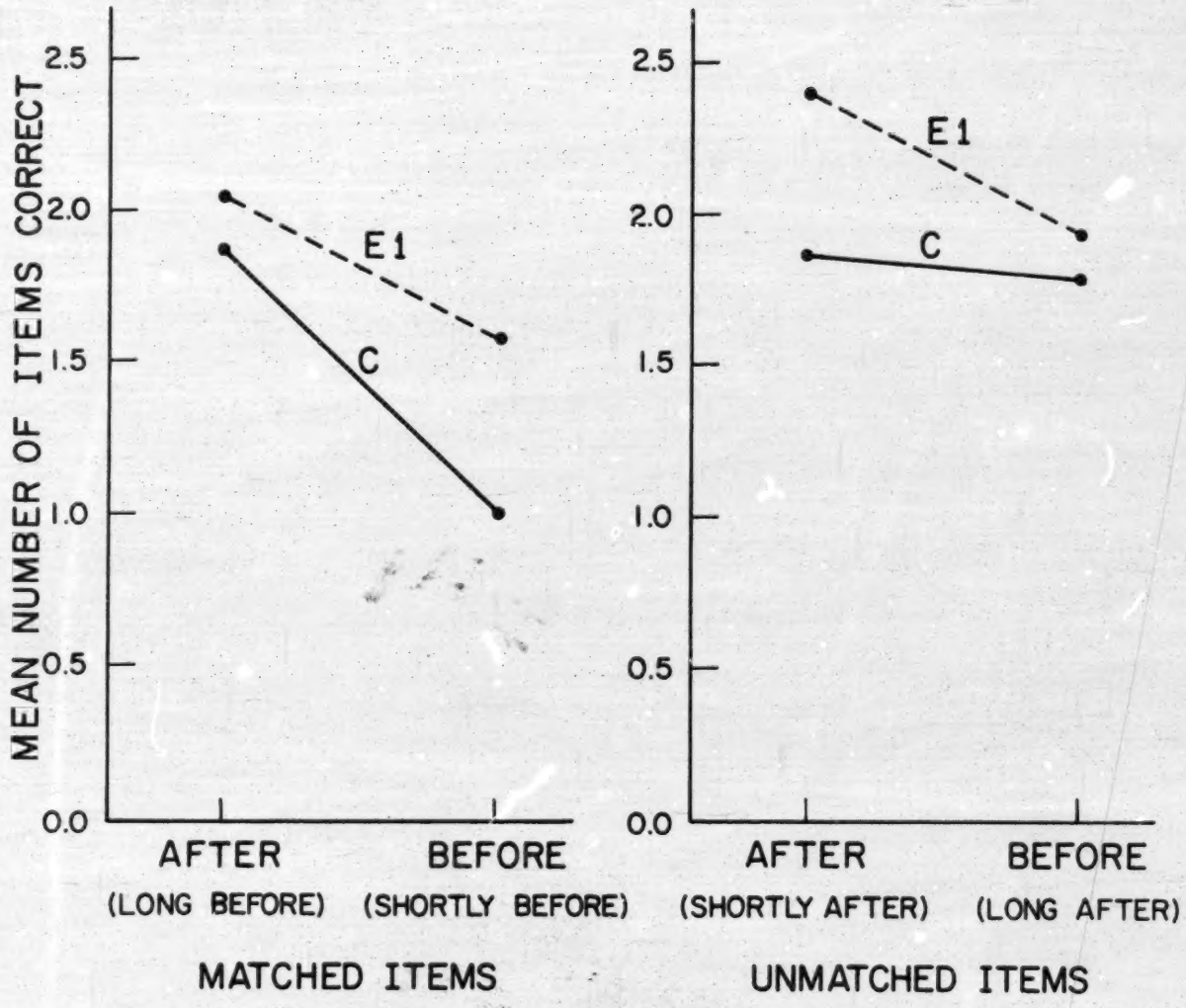


Fig. 2. Groups by position of item interaction for different types of items for Experiment A.

attenuated with increased textual distance before the inserts.

EXPERIMENT B

The experiment with groups E2 and E3 was designed to provide a further test of the alternative forward and backward hypotheses. The design of this experiment can be seen in Figure 1. For group E2 inserted questions occurred before Sections C, E, and G whereas, for group E3 they occurred after these sections.

Forward or Backward Effect

The adjusted mean performances of the two groups, on the items in test *T1* which were drawn from the pages in C, E, and G, are shown in Table 5. The data from which these means were obtained were analyzed in a repeated measures ANOVA with covariance adjustments on the between subjects variable. This analysis showed that the overall difference between the groups was not significant, $F(1,53) = .013$. The groups by sections interaction effect, however, was significant, $F(2,108) = 6.81$, $p < .002$.

TABLE 5

Adjusted Means on Sections C, E, and G by Groups for Experiment B

Group	Section C	Section E	Section G
E2	2.27	3.22	2.33
E3	1.75	3.84	2.16

Tests of the simple main effects (Winer, 1962, p. 311) for groups, for each section of the material, revealed that the superiority of E2 on Section C approached significance, $F(1,161) = 3.1$, $p < .10$, that the superiority of E3 on Section E was significant, $F(1,161) = 4.4$, $p < .05$, and that there was no significant difference between the groups on Section G.

These data provide important information about the nature of the forward and backward effects. On Section C, prior to which only group E2 had received inserted questions, the performance of E2 was superior. The inspection behaviors of *S*s in E2 had apparently been shaped, on seeing the earlier questions, so that they attended to the specific factual information tested by the inserted questions and the criterion test. The extent to which inserted questions can have a facilitative shaping effect depends on the extent to which *S*s habitual inspection behaviors are inappropriate for the particular text

material. Whether the effect would be less marked with questions of a different type from those used in the present study largely remains to be shown. Watts and Anderson (1971), in fact, reported data suggestive of a review effect rather than a shaping effect with "application" questions.

Prior to Section E, on which the performance of E3 was superior, both groups had encountered inserted questions. This superiority was obtained despite the fact that group E2 had encountered two sets of inserted questions, including one immediately prior to the section. The superiority of E3 can, therefore, be attributed to a review effect, occurring because of the inserted questions immediately after the section. Thus, it appears that inserted questions may serve a review function only if appropriate inspection behaviors have been used.

The non-significant difference on the final Section G cannot be accounted for but an explanation might be due to a recency effect obliterating the advantage to E3 of having questions at the end of the text immediately prior to taking the criterion test.

Replication of Results of Experiment A

The primary analysis for Experiment B, reported above, indicated that both shaping and review effects occur. The data in Experiment A suggested that the review effect was greatest with matched items. A further analysis was made of the data from Experiment B to determine whether the effect on matched and unmatched questions had been replicated. In order to do this the data from control group C in Experiment A was included.

For group E2 the pages immediately before inserts were 6, 12 and 18 and those after were 7, 13, and 19. These constitute page group A in Table 6 in which the adjusted mean performances of the groups

TABLE 6

Adjusted Means on Matched and Unmatched Items
Before and After Inserts by Groups for Experiment B

		Before		After	
		Matched	Unmatched	Matched	Unmatched
Page Group A (6,7,12,13, 18,19)	E2	1.40	1.31	1.38	1.63
	C	1.09	1.33	1.43	1.18
Page Group B (9,10,15, 16,21)	E3	1.28	1.20	.72	.90
	C	.92	1.43	.44	.95

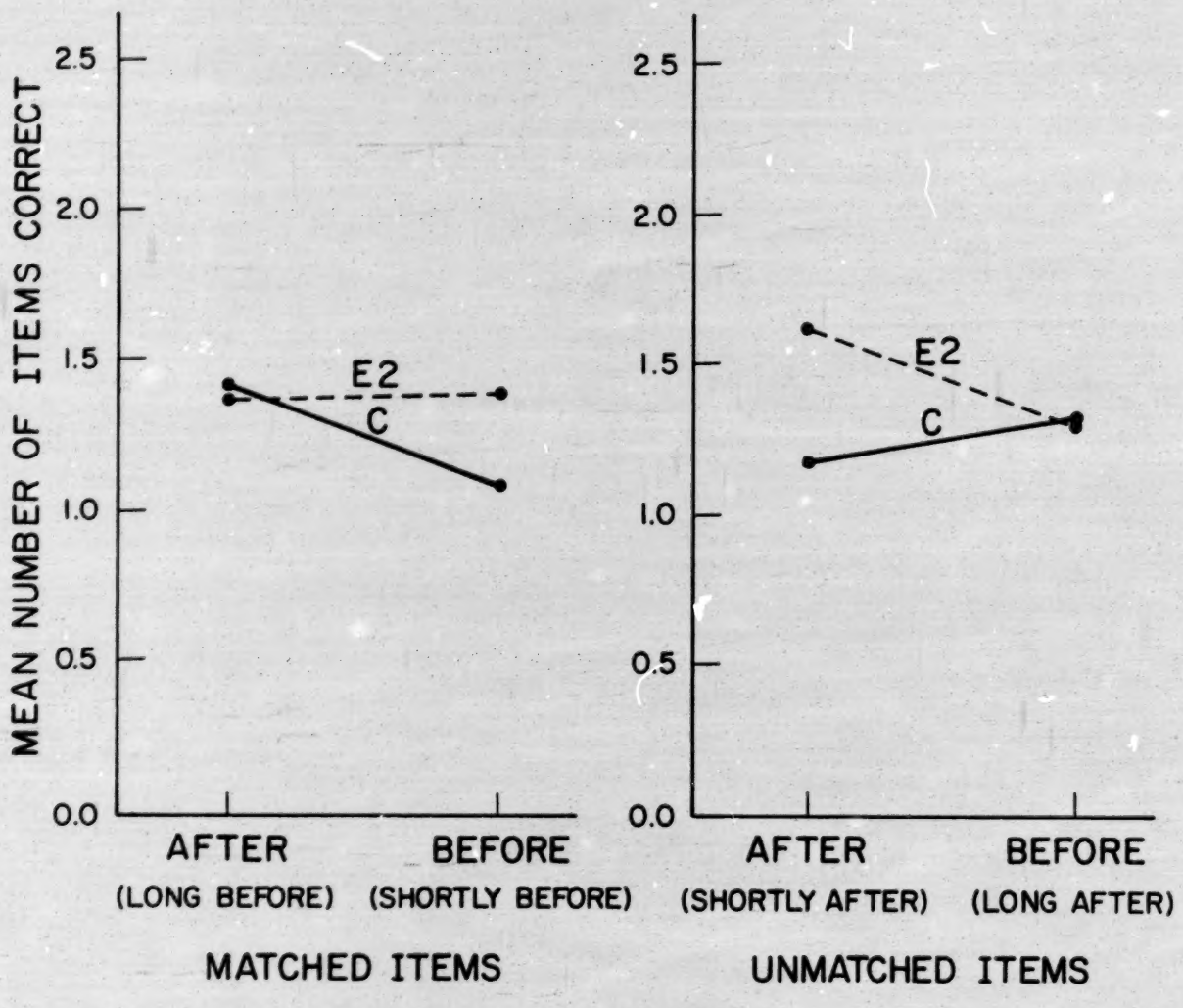


Fig. 3. Groups by position of item interaction for different types of items for Experiment B.

are shown. Page group B is the set of pages before (9, 15, 21) and after (10, 16) for group E3.

The analysis for groups E2 and C, with data from page group A, produced precisely the results noted in Experiment A, *viz* a significant groups x page position x item type interaction, $F(1,54) = 6.07$, $p < .02$. The graph of this interaction, in Figure 3, shows the effect to be the same as before, superior performance for the group with inserted questions on matched items from pages immediately prior to inserted questions, $F(1,215) = 2.1$, $p < .15$, and on unmatched items immediately after inserted questions, $F(1,215) = 4.4$, $p < .05$. The analysis for groups E3 and C revealed a non-significant groups x page position x item type interaction, $F(1,54) = .07$, but, in this case, the groups x item type interaction was significant, $F(1,54) = 3.94$, $p < .05$. Group E3 was significantly superior on matched items regardless of distance from the insert but there was no significant difference on unmatched items.

CONCLUSIONS

Previous research on the effect of inserted questions has shown both direct and indirect facilitation of subsequent performance on questions relating to the text. The indirect facilitation has occurred on items to which, it had been demonstrated, there was no direct transfer model in which knowledge of the answer to one question facilitates answering another. In this study the matched questions were constructed in such a way that the answer to one could not in any way provide the answer to the other member of the pair. Yet review of the material required to answer an inserted question facilitated performance on its matched item, provided that the review occurred within a page or so of the relevant material.

The nature of the retrieval phenomenon, or memory search, which gives rise to the facilitation is not yet clear. The important variable could be similarity of subject matter though, in this study, the similarity occurred only in the subject matter of the sentence from which the responses were deleted, not in the responses themselves. Alternatively the important variable could be proximity of material in the text, with greater facilitation for contiguous material. A further possibility is that verbatim recall of the original sentence to complete the inserted question provided also the word required to complete the matched question, despite the fact it was also deleted from the inserted question. Not all of the questions required simple verbatim recall but further research with controlled use of verbatim and paraphrase items will clarify this issue.

This study also confirmed the existence of a forward effect on the unmatched items. The results of Experiment B provide support for

a shaping hypothesis, suggesting that, insofar as *Ss* habitual inspection behaviors are inappropriate, inserted questions will serve to shape appropriate behaviors. The use of questions testing highly specific factual information probably highlighted this effect. The results of Experiment A suggested that, in addition to a shaping effect, the inserted questions serve also to control general attentional behaviors. *Ss* performed better on material from pages immediately after the inserts. Such control of attention, however, was only achieved with text related questions.

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